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DRAWINGS ATTACHED

1 317 266

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(54) SEMICONDUCTOR RECTIFIER ASSEMBLIES

(71) We, GENERAL ELECTRIC COMPANY, a corporation organized and existing under the laws of the State of New York, United States of America, of 1 River Road, Schenectady 12305, New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a semiconductor rectifier assembly for obtaining a rectified electrical output; and to a combination of an alternator with a bridge rectifier assembly.

The invention finds particular, though not exclusive, application in the field of rectifying the output of an alternator in an automobile where the now proposed rectifier assembly may be integrated with a portion of the alternator housing. It is conventional practice to utilize with a three phase alternator, such as is incorporated in an automobile, for example, a rectifier bridge to convert the three phase alternating current output of the alternator into a rectified form more easily distributed and used. There will be described below how the present invention has enabled us to provide a rectifier bridge capable of cooperation with an alternator to form a simple, efficient, low cost combination.

In more general terms the present invention provides a rectifier assembly comprising a first, electrically conductive, heat sink member and a second, electrically conductive member insulated from said first member, said first and second members having first and second surfaces respectively which are in spaced apart, substantially parallel relationship; at least one pair of non-discrete semiconductor rectifier arrangements each rectifier arrangement comprising at least one semiconductor body containing a rectifier junction, and the or each pair of semiconductor rectifier arrangements being located between said first and second surfaces and connected in series with like polarity between said first and second members, one rectifier arrangement of the pair having one pole thereof in thermal and ohmic contact with said first surface and the other rectifier arrangement of the pair having the opposite pole thereof in thermal and ohmic contact with said second surface, and the pair of rectifier arrangements having a lead connected to the juncture of the other adjacent poles thereof; means for securing said first and second members so as to compress the rectifier arrangements between said first and second surfaces to provide said thermal and ohmic contact thereto; and means which provides a passivant disposed in contact with said semiconductor bodies to protect the junctions thereof and which cooperates with said first and second members to provide a protective enclosure for the semiconductor rectifier arrangements taken as a whole.

In the preferred practice of the invention applied to an automobile alternator the heat sink member above specified is a part of the alternator housing, such as an end bell where it can have cooling air flow over it, and it may be provided with fins to this end. At least two pairs of semiconductor rectifier arrangements are provided to form a bridge rectifier; three pairs being used where a three phase alternator is employed, the leads from the junctures of the rectifier arrangement pairs being connected to the alternator output leads.

It is a feature of the present invention that each rectifier arrangement is non-discrete. To this end each rectifier arrangement comprises at least one semiconductor body which is not individually housed such as to provide a discrete device separable from the remainder of the assembly. For convenience each rectifier arrangement will be considered as comprising a single semiconductor body containing a rectifier junction though a number of such bodies could be used together. A convenient semiconductor body structure is a relatively thin

flat body having opposed major surfaces which constitute the poles of the rectifier and containing a rectifier junction which extends through the body parallel to the major surfaces and emerges at the peripheral edge. In a conventional rectifier device such a body, or other form of semiconductor rectifier body, is mounted in a housing or envelope sealed to protect the body against the admission of contaminants, the housing or envelope including a pair of opposed electrodes which provide the external terminals or poles of the rectifier device, which is a self-sufficient discrete structure. Pairs of such rectifier devices can readily be mounted to form a bridge rectifier, each device being individually protected, and being, in theory at least, demountable as a discrete structure. However, the present invention adopts a different approach in that it stems from considering how to take the basic semiconductor rectifier bodies required in the rectifier assembly, conveniently but not necessarily in the form of pellets, and provide a protection for them as a whole while at the same time providing passivation of the individual bodies. Thus, when considered individually the rectifier arrangements employed by the present invention are non-discrete in that they are not separable into individual devices.

The invention can be put into practice in various ways and to better illustrate these ways, a number of embodiments of the invention will now be described in conjunction with the accompanying drawings, in which:

Figure 1 is a circuit diagram of a three phase alternating current rectifier bridge;

Figure 2 is an end view of an alternator and rectifier bridge assembly in a combination constructed according to our invention;

Figure 3 is an elevation of the rectifier bridge assembly with portions of the associated alternator broken away;

Figure 4 is a sectional view taken along section line 4—4 in Figure 2;

Figure 5 is an elevation of a modified bridge subassembly;

Figure 6 is a sectional view taken along section line 6—6 in Figure 5;

Figure 7 is a sectional view of a rectifier assembly incorporating the modified bridge sub-assembly of Figures 5 and 6;

Figure 8 is a sectional view of part of another modified rectifier bridge assembly;

Figure 9 is a plan view of a rectifier bridge of a further assembly according to our invention;

Figure 10 is a sectional view of a rectifier bridge assembly taken along section line 10—10 in Figure 9;

Figures 11 and 12 are elevations of semiconductor discs used in another embodiment of our invention;

Figure 13 is a sectional view of a rectifier bridge assembly incorporating the semiconductor discs of Figures 11 and 12; and

Figure 14 is a sectional view taken along section line 14—14 in Figure 13.

Referring initially to Figures 1 through 4 inclusive, a three phase alternator 100 is provided with a housing end bell 102 formed of metal so that it is both thermally and electrically conductive. The housing end bell is provided with a plurality of air circulation ports 104. On the exterior surface of the housing a plurality of heat dissipation fins 106 are provided. Preferably the housing end bell is formed by casting, and the heat dissipation fins are formed integrally with the housing during casting. The housing end bell is provided with a recess 110 having an outer surface 112 located therein. The end bell is provided with an aperture located centrally within the recess having a plurality of lugs 116 formed integrally with the end bell projecting inwardly of the aperture. The lugs are circumferentially spaced to define grooves 118 therebetween. Integrally formed heat dissipation fins 120 are formed on the interior surface of the end bell. A sealing surface 122 is provided on the exterior surface of the end bell peripherally of the recess.

A rectifier bridge sub-assembly 108 is provided with a thermally and electrically conductive plate 124 having an annular recess or seat 126 machined therein. An O-ring seal 128 is sealingly fitted between the seat and the sealing surface 122 and defines with the plate 124 and recess 110 an enclosure in which rectifier elements are received. Interposed between the inner surface 130 of the plate and the parallel outer surface 112 of the recessed end bell are three pairs of rectifier arrangements 132 disposed symmetrically about the axis of the aperture in the recess. Each rectifier arrangement of a pair comprises a respective semiconductor body, 134 and 136. Each body is in the form of a flat monocrystalline pellet having two parallel planar major surfaces, and each pellet includes a first region 138 of one conductivity type and a second region 140 of an opposite conductivity type. A rectifier junction 142 is formed at the intersection of the first and second regions within each pellet and extends to the peripheral edge of the pellet. Thus each pellet acts as a rectifier body and the major surfaces provide the poles of the body by which contact is made thereto. To improve the ability of the pellets to withstand high blocking voltages they are shown beveled around their periphery, as is conventional practice. To protect the pellets from contamination a passivant layer 144 is positioned around the periphery of each to cover the junction emergent thereat. The passivant layer is

formed of a substantially impervious dielectric material having a high resistivity and high dielectric strength. It is preferred to utilize glass to form the passivant layer, although dielectrics, such as silicone rubbers, for example, may also be employed with a lesser degree of effectiveness. One major surface of the pellet 134 in each pair (being a pole of given polarity) lies in intimate thermally and ohmic electrically conductive relation with the conductive plate 124 while a second major surface of opposite conductivity type of the pellet 136 in each pair (being a pole of the opposite polarity) lies in intimate thermally and ohmic electrically conductive relation with a contact element 145, which may be a disc of a metal having a thermal coefficient of expansion which approximates that of the semiconductor crystal, such as tungsten or molybdenum, for example. The pellets 134 and 136 are electrically connected in series between plate 124 and surface 112 with like polarity. The contact element 145 forms a low impedance thermal and electrical interconnection between the semiconductor elements 136 and the outer surface of the recessed end bell.

In each pair of rectifier arrangements interposed between the adjacent major surfaces of the pellets 134 and 136 is an electrically conductive strip 146. A portion 148 of each strip extends inwardly through the aperture in the end bell of the alternator to form input terminals for the rectifier bridge assembly that cooperate with output leads of the alternator, not shown. A dielectric potting material 150, such as silicone, epoxy, or phenolic resin, surrounds and encapsulates the semiconductor pellets and a portion of each strip 146. The contact elements protrude slightly from the encapsulant to assure that they securely engage the outer surface of the recess.

Fitted over the portions 148 of the strips is a lock coupler 152 having a plurality of radial lugs 154 peripherally formed thereon. The lugs 154 are sized to be smaller than the grooves 118 so that they can readily pass therethrough. Centrally formed in the coupler is a threaded sleeve 156. The threaded sleeve is aligned with a somewhat larger bore 158 in the plate and potting material. A mounting bolt 160 passes through the bore and is engaged with the threaded sleeve. An output lead 162 is pressed into engagement with the plate by the bolt.

It can be readily appreciated that the rectifier bridge assembly and alternator end bell may be easily constructed and assembled. The alternator end bell with the heat dissipation fins, recess, and aperture may be formed simply by known metal casting techniques. The semiconductor pellet 134, strip 146, semiconductor pellet 136, and contact element 145 associated with each pair of rectifier arrangements may be formed as a stack by soldering the adjacent elements, the pellet 134 also being soldered to the plate 124. Thereafter the potting material 150 may be molded around the parts. The central bore 158 in the plate and potting material require no special mold configuration to form, since it may, if desired, be formed after the potting material is molded in place. The lock coupler 152 can be separately molded and thereafter slipped over the ends of the strips. The lock coupler 152 need not be permanently attached to the strips. Alternatively, the lock coupler may, if desired, be formed integrally with the potting material. The lugs 154 of the lock coupler may be reinforced, if desired. For example, reinforcing fingers may be joined to the threaded sleeve 156.

A very significant advantage of combination of the rectifier bridge sub-assembly with alternator housing as shown is that the rectifier sub-assembly may be connected to the alternator after it is otherwise completely assembled. It is merely necessary to pass the lugs of the lock coupler through the grooves in the aperture of the end bell after the output leads of the alternator have been attached to the strips of the rectifier assembly. Then by turning the rectifier assembly slightly so that the lugs of the rectifier assembly overlie the lugs of the alternator end bell and inserting and tightening the bolt 160 the rectifier assembly is fully operational. If the lock coupler can be brought into position from the inside of the end bell of the alternator, as by attaching the rectifier assembly to the end bell before the end bell is attached to the alternator, there is no necessity of providing grooves in the aperture of the end bell and the lock coupler can be provided with an annular flange rather than lugs. Assembly of the rectifier bridge assembly is then simplified to the tightening of one bolt in order to both mount the assembly and connect the output electrical lead which carries the rectified electrical output for external use. It is, of course, recognized that the lock connector 152 and potting material 150 may be simultaneously cast with the rectifier bridge assembly in position on the end bell. In this circumstance the bolt 160 merely attaches the output lead, since the rectifier bridge assembly is permanently locked to the alternator end bell.

The electrical characteristics of the rectifier bridge assembly may be easily understood by reference to Figure 1. The semiconductive pellets 134 and 136 in each pair act as rectifiers. The conductive strips 146 are connected to the respective junctures of the pellets of the three pairs of rectifier

arrangements and deliver a three phase alternating current electrical input to the arrangements between the pellets 134 and 136. Depending on the polarity of the input current delivered to each pair of rectifier arrangements the input current will either be conducted to the output lead 162 through the pellet 134 and the plate 124 or to ground through the pellet 136 and the alternator end bell 102, since the alternator housing is conventionally grounded. It is appreciated that the rectifier bridge assembly may be easily adapted for a single phase input merely by omitting connection to one of the input terminals represented by strip portions 148 or by eliminating one pair of rectifier arrangements entirely. For a high voltage application each rectifier arrangement may comprise a plurality of pellets in a stack and electrically in series.

As is well understood in the art, when semiconductor bodies are conducting current, they generate heat. Unless provision is made for conducting heat away from the semiconductor bodies as quickly as it is generated they may be damaged by over heating. In the form shown the conductive plate 124 and end bell 102 act as heat sinks for the semiconductive pellets, since each pellet is provided with a major surface in low impedance electrical and thermal association with one plate. The remaining major surfaces of the pellets are in contact with the conductive strips 146 allowing an additional, although less efficient, heat dissipation path. The major portion of the generated heat is removed from the rectifier bridge assembly through the alternator end bell. This eliminates the necessity of providing heat dissipation fins as a part of the rectifier bridge sub-assembly, although such fins could be included if desired. The arrangement provided differs from conventional alternator bridge assemblies in that the bridge need not itself be provided with heat dissipation fins nor is it essential that the location of the bridge be chosen to allow impingement of air directly on the rectifier bridge elements.

It is a feature of the rectifier bridge assembly that heat is primarily removed through the alternator housing. This then eliminates any necessity of mounting the rectifier bridge assembly for direct impingement by ambient air in order to achieve the desired level of cooling. Accordingly, the amount of contaminants that are brought into contact with the bridge assembly may be greatly reduced. This allows the further advantage that the degree of contaminant protection provided for the semiconductive crystals making up the pellets can be reduced with less risk to reliability. Or, alternatively stated, comparable levels of reliability can be achieved with less contaminant protection. For example, it may be desirable to eliminate the potting material or to utilize a potting material less impervious to contaminants than has been used in the past. Alternatively the O-ring seal may be omitted or may be replaced with a non-sealing electrically insulative spacer.

To illustrate another manner in which our invention may be practiced, in Figures 5 and 6 a rectifier bridge sub-assembly 200 is illustrated. The sub-assembly includes a dielectric substrate 202 having angularly spaced ear portions 204 each provided with an aperture 206. An annular metal eye 208 is fitted into each aperture and provided with a rolled edge 210 at each end that overlies a conductive strip 212, which may be metallization printed onto the substrate. The conductive strips associated with each eye are located in opposed relation on opposite major surfaces of the substrate. Attached to each strip at a point remote from the aperture with which it is associated is a semiconductive body 214. The semiconductive bodies each are provided with at least one rectifying junction. The semiconductive bodies adjacent one major surface of the substrate are mounted with an N-type conductivity surface next adjacent the conductive strips, and the semiconductive bodies adjacent the opposite major surface are mounted with a P-type conductivity surface next adjacent the conductive strips. The semiconductive elements may conveniently be soldered to the conductive strips by conventional techniques. Overlying the semiconductive pellets so as to cover the remaining major surface thereof not contacting the strips are contact plates 216, which are preferably soldered to the semiconductive bodies. A dielectric passivant material 218 such as silicone rubber or glass, seals the periphery of the semiconductive bodies left exposed by the strips and contact plates. Each semiconductive body together with its associated dielectric passivant and contact plate forms a semiconductive pellet 219. A central aperture 220 is provided in the rectifier sub-assembly.

In Figure 7 the rectifier sub-assembly is shown in a typical application. A thermally and electrically conductive member 222, which may be an alternator housing, is provided with at least one heat dissipation fin 224. The conductive member is provided with a threaded blind bore 226. A stud is threaded into the bore and is provided with a nut 230 fixed thereto. The fixed nut bears against a sandwich provided by the dielectric substrate and two flanking insulative washers 232 and 234. The fixed nut and stud hold the rectifier sub-assembly in position with the outer surface of the semiconductive pellets adjacent one major surface bearing against the inner surface of the

conductive member 222 in thermally and electrically conductive relation. To supplement the dielectric passivant associated with the sub-assembly in protecting the semiconductive elements from contamination an O-ring seal 236 is interposed between the sub-assembly and the inner surface of the conductive member 222.

An annular housing 238 provided with a central insulative lining 240 is mounted on the stud to overlie the fixed nut and provide a conductive flange 242 in electrically conductive relation with the semiconductive pellets of the rectifier sub-assembly. An electrical output lead 244 is shown welded to the flange. A nut 246 is provided rotatably threaded to the stud to urge the annular housing 238 into engagement with the rectifier sub-assembly. The alternating current input leads 248 for the rectifier bridge assembly are inserted into the eyes 208 of the sub-assembly. An O-ring seal 250 is interposed between the rectifier sub-assembly and the flange 242 of the annular housing. While the construction of the modified rectifier bridge assembly of Figure 7 differs substantially from that of Figures 2 through 4 inclusive, the function and advantages are similar. The flange 242 and the facing surface of member 222, which acts as a heat sink, correspond to the facing surfaces of plate 124 and recess 112 respectively, each pair of rectifier arrangements being connected in series between the two surfaces. The members 238 and 222 together with the O-ring seals 236 and 250 and the interposed portions of disc 202 defining an enclosure for the three pairs of semiconductor bodies.

Figure 8 illustrates another modified form of our invention. An electrically conductive member 300, which may be an alternator housing portion, is provided with a plurality of apertures 302 and a threaded bore 304. A rectifier bridge sub-assembly 306 is provided with an electrically and thermally conductive plate 308 provided on the surface facing away from member 300 with heat dissipation fins 310. Between the spaced facing parallel surfaces of the members 300 and 308 a plurality of pairs 312 of rectifier arrangements are provided. The pairs may be identical in number and arrangement as in the rectifier bridge assembly of Figures 1 to 4. The pellets are individually passivated and although no annular seal is provided, potting material 314 disposed between the facing surfaces of the members 300 and 308, extends radially outwardly of the rectifier arrangements taken as a whole and with the members 300 and 308 encloses the rectifier arrangements. A difference in construction between the bridge assembly previously described and the assembly 306 is that the latter bridge assembly is not provided with an electrically and thermally conductive plate interposed between each pair of rectifier arrangements and the adjacent mounting member. Thus in the bridge sub-assembly 306 one pellet of the pair bears directly against the surface of the member 300. To protect the exposed major surface of the semiconductive pellets that bear against the conductive member a thin metallized coating may be deposited over this major surface of the semiconductive pellets. Alternatively a contact plate may be embedded in the potting material overlying each pair.

Another variation from the rectifier bridge assembly of Figures 1 to 4 is that the potting material is provided with an annular shoulder 316 protruding from the plate 308. A stud 318 extends through a bore 320 in the potting material and is threadedly engaged in the bore 304. A domed washer 322, electrical output lead 324, and insulative washer 326 are interposed between the head of the stud and the plate 308, so that the electrical output lead is in conductive relation with the plate 308. The shoulder 316 and washer 322 are sized so that the desired compressive force is provided to hold the rectifier bridge sub-assembly in engagement with the surface of the conductive member 300.

The rectifier bridge sub-assembly 306 is essentially similar to the previously described rectifier bridge assembly in operation. The bridge sub-assembly 306 can be easily mounted to the exterior surface of an alternator housing after the alternator is otherwise fully assembled. The exterior mounting allows the stud 318 to be quickly and conveniently positioned. The shoulder 316 offers the advantage of stopping the stud before excessive compressive force is placed on the bridge assembly. The bridge sub-assembly 306 is significantly less costly than the sub-assembly of Figures 1 to 4 by reason of the elimination of the conductive plate interposed between each of the pairs of rectifier arrangements and the surface of the alternator housing.

In Figures 9 and 10 a modified rectifier bridge assembly 400 is illustrated. As shown in Figure 10 the rectifier bridge assembly is mounted on a thermally and electrically conductive member 402 having a plurality of heat dissipation fins 404. The member is provided with an aperture within which an insulative bushing 406 having a flange 408 is fitted. A bolt 410 conductively associated with electrical output lead 412 is insulated from the member 402 by the bushing and is threadedly and conductively associated with a plate 414 of the rectifier bridge assembly. Offset from its point of connection to the bolt the plate is provided with an aperture 416. A plurality of pairs of rectifier arrangements 418 are interposed between the conductive member 402 and the plate 414. The rectifier pairs are generally

similar to those shown and described in connection with the preceding embodiments, except that the strips lying between the semiconductor pellets of each pair differ somewhat in configuration. The strips 420a, 420b, and 420c are each somewhat differently formed, since the aperture 416 in the plate through which the strips pass is not positioned to allow a symmetrical arrangement about the center bolt as in the preceding embodiments. It is to be noted that the strip 420*b* traverses the distance between the aperture and the pair of pellets between which one end of it is disposed in a circuitous manner to avoid touching the bolt. The pair of rectifier arrangements including all but the outer extremities of the strips are encapsulated by potting material 422. The pellets are protected by passivant material (not shown) applied to the peripheral edges thereof and it will be seen that the potting material disposed outwardly of the rectifier arrangements encloses them in conjunction with the cooperating portions of members 402 and 414. The potting material extends into and through the aperture 416 to insure insulation of the strips from the plate.

The operation of the rectifier bridge assembly 400 is generally similar to that of the preceding embodiments. It is to be noted that, again, the rectifier bridge assembly may be mounted and the output lead 412 attached by the single operation of inserting and tightening the bolt 410. Also, heat from the rectifier bridge assembly is still removed primarily through the conductive member 402.

In Figures 11 through 14 inclusive a more compact form of our invention is shown. Rectifier bridge assembly 500 is mounted in thermally and electrically conductive relation to member 502 by bolts 504. A significant distinction of the rectifier bridge assembly 500 is that the number of semiconductive elements for a three-phase bridge is reduced from six in the other bridge assemblies disclosed to two. The three pairs of rectifier arrangements in the bridge assembly are comprised of planar semiconductor discs 506 and 508. The disc 506 is formed generally of P type conductivity semiconductive material into which three radially arranged N type conductivity areas 510 have been formed. Each of the N type conductivity areas lie adjacent the inner major surface of the semiconductor disc—that is, the major surface next adjacent the disc 508. The semiconductive disc 508 is formed generally of N type conductivity semiconductive material into which three radially arranged P type conductivity areas 512 have been formed and these lie adjacent the disc 506. The areas 510 and 512 are of similar geometric configuration and are aligned in the completed bridge assembly. Three separate contact members 514 are interposed between the spaced parallel inner surfaces of the semiconductor discs. The contact members are of a geometrical configuration to provide a low impedance electrical contact to one N type conductivity area and one aligned P type conductivity area of the semiconductor discs 506 and 508, respectively. Each of the contact members are shown provided with an integrally formed tab 516 for connection to a three phase alternating current source. Each disc thus provides three rectifier bodies in a single semiconductor disc and the aligned pairs of rectifiers mounted as aforesaid provide the pairs of rectifier arrangements series connected with like polarity as in Figure 1.

The tabs 516 extend radially outwardly through a glass passivant ring 518 in contact with the outer periphery of the discs and which also encircles the discs and with the adjacent parts of the assembly encloses them to protect against contamination. It is to be noted that only a single glass passivant ring is required to protect both discs, whereas in the other rectifier bridge assemblies six separate glass passivant layers are provided to accomplish the same result. A thin thermally and electrically conductive layer 520 is noted to overlie and protect the outer major surface of the semiconductor disc 508. If it were desired to form the rectifier bridge assembly integrally with the member 502, this element could be omitted entirely. While a void is shown between the laterally spaced contact members 514, for high voltage applications a dielectric such as glass could be provided filling this void space.

To provide electrical contact to the outer major surface of the semiconductor disc 506 an electrically conductive member 522 is provided. A low impedance electrical connection exists between the conductive member 522 and the electrical output lead 524. To allow for mounting the bridge assembly an insulative plate 526 is provided. The plate may, for example, be a reinforced resin member molded around the conductive member 522 and output lead. In an alternative form the conductive member 522 may be constructed of heavier gauge metal and the insulative plate 526 eliminated. In this arrangement insulative bushings may be used to electrically isolate the bolts from the conductive members 522. It is appreciated that the plates 520 and 522, discs 506 and 508, glass passivant 518, and contact members 514 could be readily constructed as a unitary sub-assembly capable of performing in itself all the electrical functions of a rectifier bridge assembly.

The rectifier bridge assembly 500 functions similarly as the preceding rectifier bridge assemblies. It should be noted,

however, that the construction of the rectifier bridge assembly is greatly simplified with the total number of elements required to form the rectifying function being greatly reduced.

While the rectifier bridge assembly has been specifically disclosed in connection with an alternator, it is appreciated that the bridge assembly may be mounted by other thermally and electrically conductive elements which are capable of serving both as a conduction path and a heat sink.

WHAT WE CLAIM IS:—

1. A rectifier assembly comprising a first, electrically conductive, heat sink member and a second, electrically conductive member insulated from said first member, said first and second members having first and second surfaces respectively which are in spaced apart, substantially parallel relationship; at least one pair of semiconductor non-discrete rectifier arrangements each rectifier arrangement comprising at least one semiconductor body containing a rectifier junction, and the or each pair of semiconductor rectifier arrangements being located between said first and second surfaces and connected in series with like polarity between said first and second members, one rectifier arrangement of the pair having one pole thereof in thermal and ohmic contact with said first surface and the other rectifier arrangement of the pair having the opposite pole thereof in thermal and ohmic contact with said second surface, and the pair of rectifier arrangements having a lead connected to the juncture of the other adjacent poles thereof; means for securing said first and second members so as to compress the rectifier arrangements between said first and second surfaces to provide said thermal and ohmic contact thereto; and means which provides a passivant disposed in contact with said semiconductor bodies to protect the junctions thereof and which cooperates with said first and second members to provide a protective enclosure for the semiconductor rectifier arrangements taken as a whole.

2. An assembly as claimed in Claim 1 wherein the or each lead has a portion located between the adjacent poles of the rectifier arrangements of the associated pair.

3. An assembly as claimed in Claim 1 or 2 wherein said poles of said rectifier arrangements are constituted by substantially planar faces of the semiconductor bodies which comprise said rectifier arrangements.

4. An asembly as claimed in Claim 1, 2 or 3 wherein the semiconductor bodies have rectifier junctions which are substantially parallel to said first and second surfaces and emerge at the peripheries of said bodies and wherein said passivant and protective means includes a dielectric passivant applied to the periphery of each semiconductor body.

5. An assembly as claimed in Claim 4 wherein said passivant and protective means includes a separate ring of material disposed outwardly of the semiconductor rectifier arrangements to provide said protective enclosure therefor.

6. An assembly as claimed in any one of Claims 1 to 3 wherein said passivant and protective means comprises a dielectric passivant in contact with the semiconductor bodies of the rectifier arrangements and a sealing ring encircling the rectifier arrangements and engaged between said first and second members to provide said protective enclosure.

7. An assembly as claimed in Claim 6 wherein said passivant and protective means further comprises a mass of dielectric material disposed between said first and second surfaces and within which said semiconductor rectifier arrangements are buried.

8. An assembly as claimed in any one of Claims 1 to 3 wherein said passivant and protective means comprises a dielectric passivant in contact with the semiconductor bodies of the rectifier arrangements and a mass of dielectric material disposed between said first and second surfaces and within which said semiconductor rectifier arrangements are buried, said mass of dielectric material encircling the semiconductor rectifier arrangements taken as a whole.

9. An assembly as claimed in Claim 6, 7 or 8 wherein the semiconductor bodies have rectifier junctions which are substantially parallel to said first and second surfaces and emerge at the peripheries of said bodies, said dielectric passivant being applied to the periphery of each semiconductor body.

10. An assembly as claimed in any one of Claims 4 to 9 wherein said dielectric passivant is a glass.

11. An assembly as claimed in any one of Claims 1 to 10 wherein said first surface is constituted by the surface of a recess in said heat sink member.

12. An assembly as claimed in Claim 11 wherein said securing means comprises a threaded bolt received through an aperture in said second member, an insulated member having a threaded bore engaged by the thread of said bolt, said insulated member being received in an aperture in the recessed portion of said heat sink member and having means engaging the surface of said recessed portion opposite said first surface such that on screwing up of the bolt said first and second members are drawn together.

13. An assembly as claimed in Claim 12 having more than one pair of semiconductor rectifier arrangements, said pairs

of rectifier arrangements being arranged symmetrically about the axis of said bolt.

14. An assembly as claimed in Claim 12 or 13 wherein the connecting lead from the juncture of the or each pair of rectifier arrangements passes through said insulator member.

15. An assembly as claimed in Claim 12, 13 or 14 wherein said insulator member has radial projections which engage lugs at the periphery of the aperture in the recessed portion of said heat sink member such that the insulated member is insertable through the aperture from the first surface side by passing said projections between said lugs and is then engageable with the lugs by turning the insulator member.

16. An assembly as claimed in any preceding claim in which said heat sink member has cooling fins.

17. An assembly as claimed in any preceding claim wherein said heat sink member is a part for the housing of an alternator.

18. An assembly as claimed in Claim 17 wherein said heat sink member is an end bell for an alternator.

19. In combination, an alternator and an assembly as claimed in Claim 17 or 18 said heat sink member of the assembly being a part of the housing of the alternator, and the assembly including at least two pairs of semiconductor rectifier arrangements the connecting leads from the junctures of which are connected to the outputs of the alternator such that the semiconductor rectifier arrangements provide a bridge rectifier for the a.c. output of the alternator.

20. A rectifier assembly substantially as hereinbefore described with reference to Figures 1 to 4; Figures 5 to 7; Figure 8; Figures 9 and 10; or Figures 11 to 14 of the accompanying drawings.

21. In combination an alternator and a rectifier assembly substantially as hereinbefore described with reference to Figures 1 to 4; Figures 5 to 7; Figure 8; Figures 9 and 10; or Figures 11 to 14 of the accompanying drawings.

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FIG.1.

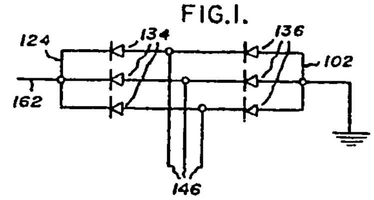


FIG.3.

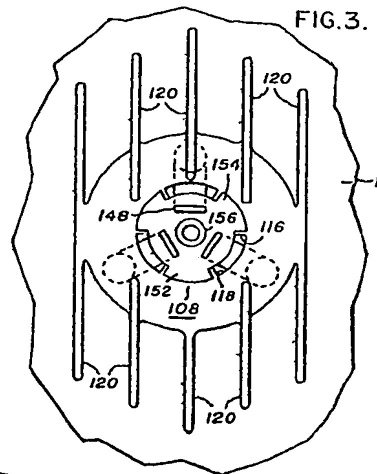
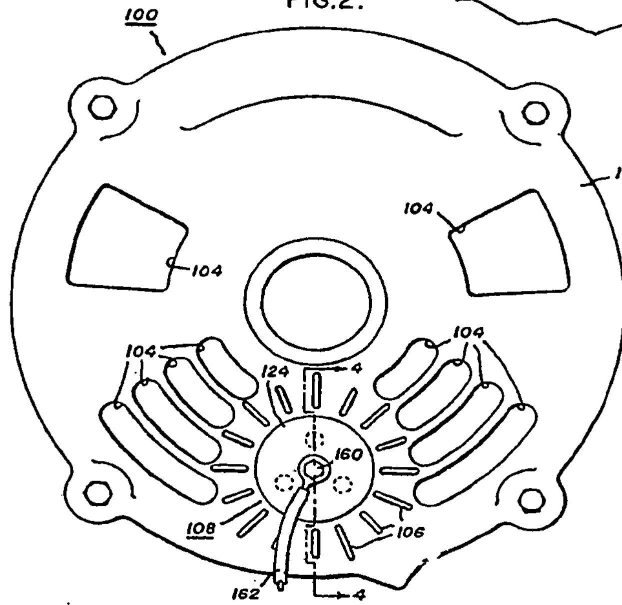


FIG.2.



1317266 COMPLETE SPECIFICATION

4 SHEETS

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Sheet 2

FIG.4.

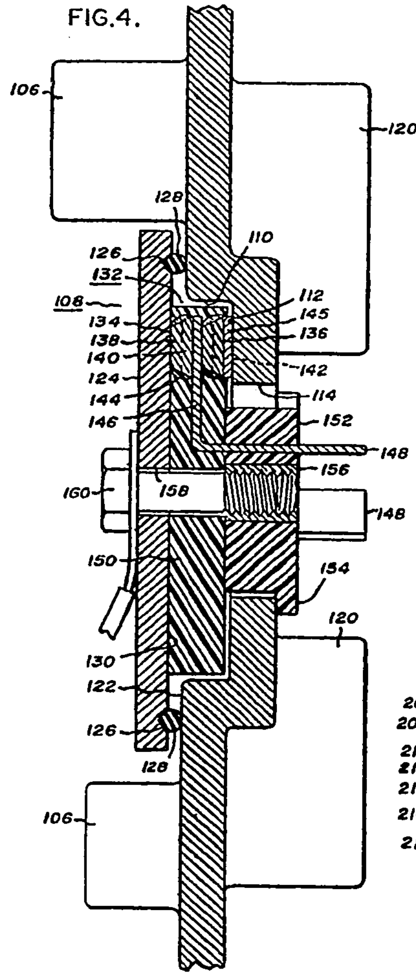

FIG.5.

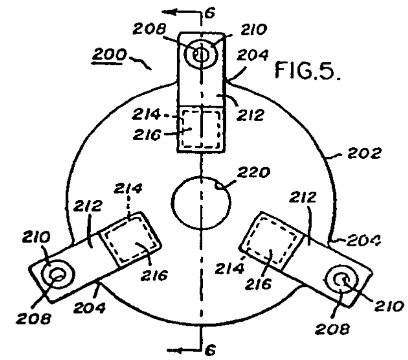

FIG.7.

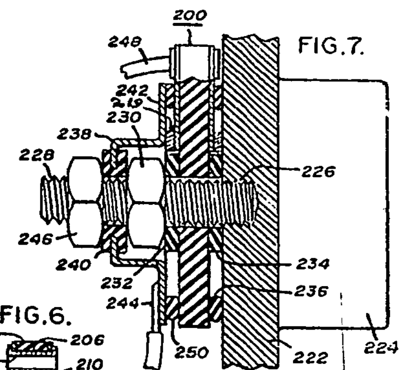

FIG.6.

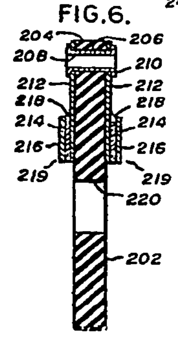

FIG.8.

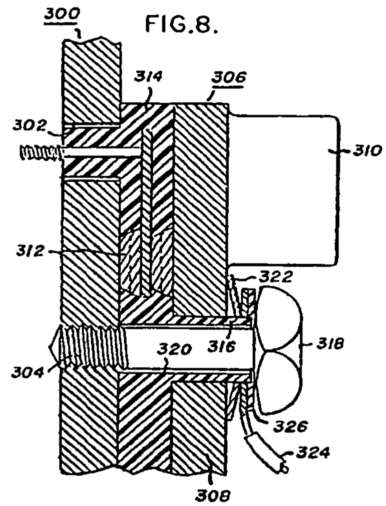

FIG.9.

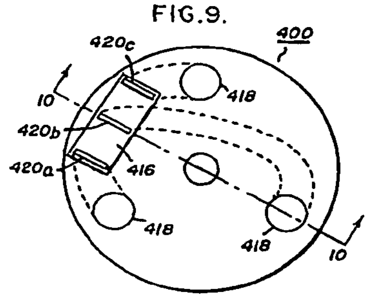

FIG.10.

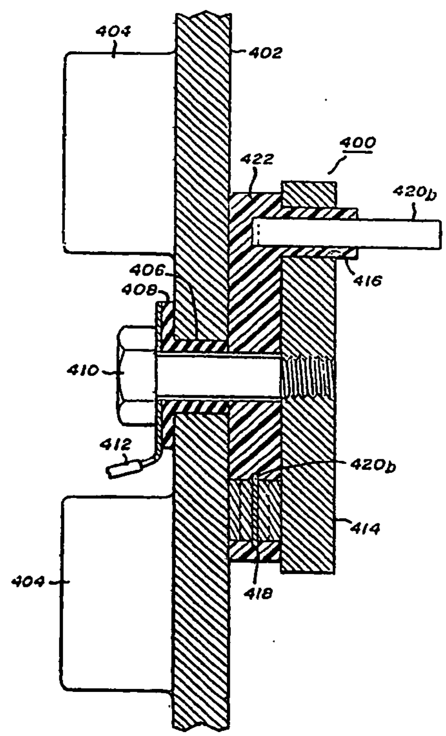

FIG.11.

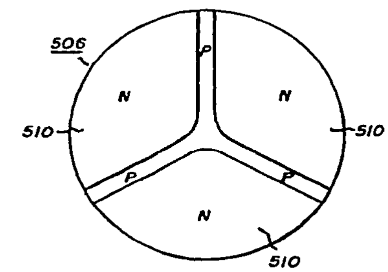

FIG.12.

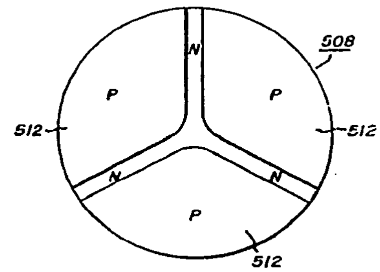

FIG.13.

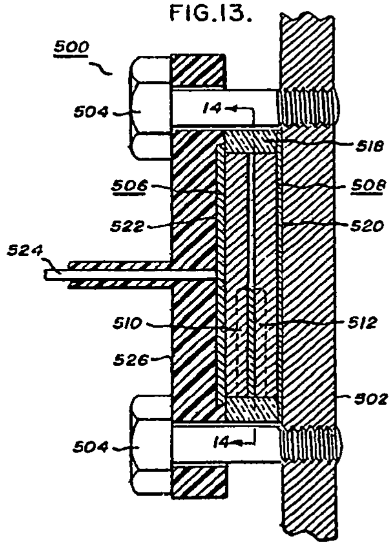

FIG.14.